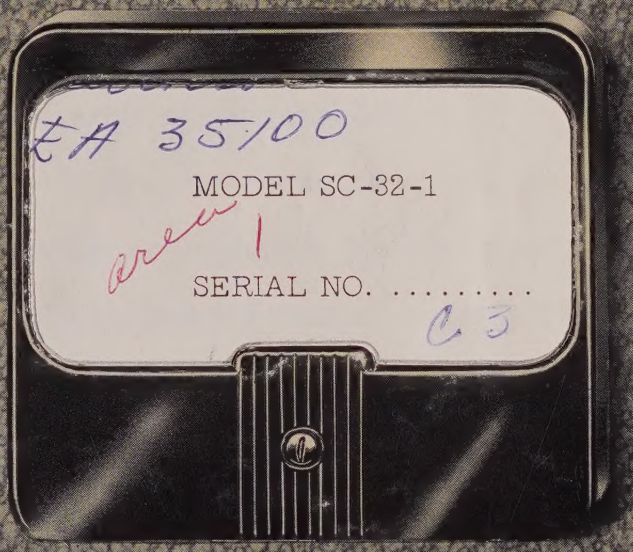
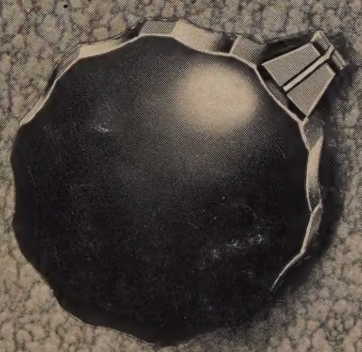
first in Performance Reliability and Quality

Kepco INSTRUCTION MANUAL

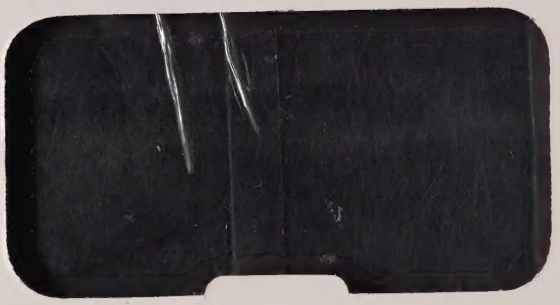
VRPS*





* VOLTAGE REGULATED POWER SUPPLIES

Kepco



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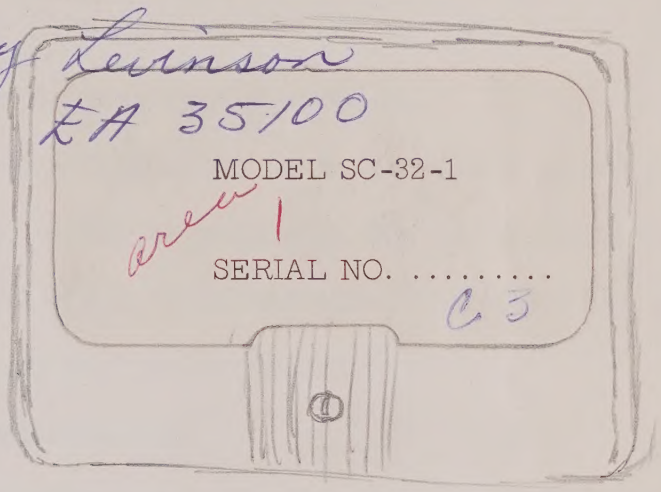

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SEMI-CONDUCTOR

VOLTAGE REGULATED POWER SUPPLY

MODEL SC-32-1

OUTPUT VOLTAGE DC: 0-32 volts continuously variable.

OUTPUT CURRENT DC: 0-1 ampere continuous duty.

REGULATION: In the range 0-32 volts, the output voltage variation is less than 0.01% or 0.002 volt, whichever is greater, for load variation from 0 to 1 ampere, and less than 0.01% for line fluctuation from 105-125 volts.

RIPPLE VOLTAGE: Less than 1 millivolt RMS.

RECOVERY TIME: 50 microseconds.

STABILITY: The output voltage variation for a period of eight hours is less than 0.01% or 0.002 volt (whichever is greater). When this unit is turned on from a cold start, approximately 3/4 of an hour is required for the unit to reach equilibrium. The drift during the 3/4 hour period is less than 1%.

AMBIENT OPERATING TEMPERATURE: 50°C maximum. Over-temperature protection provided. Unit turns off when over-temperature occurs. Power on-off switch on front panel resets unit.

TEMPERATURE COEFFICIENT: Output voltage changes less than 0.01% per °C.

OUTPUT IMPEDANCE: Less than 0.01 ohm from DC to 1 KC. Less than 0.1 ohm from 1 KC to 100 KC.

SHORT CIRCUIT PROTECTION: When the load exceeds the maximum output current by 20% a transistor amplifier automatically increases the impedance

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of the series pass transistors so that their wattage dissipation rating is never exceeded. A control which is available at the rear of the unit can be adjusted so that the over-current can be set from 0 to 120% of full load.

FUSE PROTECTION: Input fuse on front panel.

The negative reference supply and amplifier is separately fused. This fuse is located on the power supply chassis directly behind the front panel. This fuse has been designed into this unit to protect the reference amplifier in the event of any internal failure.

The voltage control circuit is separately fused. This fuse is located on the inside of the rear apron of the chassis below the output terminations. This fuse has been designed into this unit to protect the 10 turn voltage control in the event of any internal failure or accidental removing of jumper bars on the rear terminations when the unit is operating.

POWER REQUIREMENTS: 105-125 volts, 50-65 cycles.

OUTPUT TERMINATIONS: DC terminals are clearly marked on the front panel. All terminals are isolated from the chassis. Either positive or negative terminal of the DC output may be grounded. A terminal is provided for connecting to the chassis. The DC terminals are also brought out to a barrier terminal board at the rear of the unit.

Two terminals on the rear terminal board are provided for remotely sensing the error signal directly at the load. This connection compensates for the voltage drop in the wires connecting the power supply to the load.

Two terminals on the rear terminal board are provided for remotely controlling the output voltage. This feature is called "Remote Programming".

For each 300 ohms change in remote control resistance the output voltage changes by approximately one volt.

METERS: Voltmeter: 0-50 volts, 2-1/2" wide view.

Ammeter: 0-1 ampere, 2-1/2" wide view.

CONTROLS: Power on-off switch; ten turn voltage control on front panel; overload current control at the rear of the unit.

PHYSICAL SPECIFICATIONS: Height 3-1/2", width 19", depth 13", color Kepco standard gray hammertone. This unit is designed for bench use or relay rack mounting. Carrying handles are provided on the front panel.

OPERATING INSTRUCTIONS: This Semi-Conductor Voltage Regulated Power Supply is shipped without any internal packing material and may be put into operation immediately.

The remote error sensing terminals are connected directly to the rear output terminals by means of jumper bars on the barrier terminal board. The power supply is, therefore, set up for best regulation at either the front or rear output terminations.

The remote programming terminals are connected directly to the front panel voltage control by means of jumper bars on the barrier terminal board. The power supply is, therefore, set up for control of the output voltage from the front panel control.

PROCEDURE FOR OPERATING POWER SUPPLY FOR NON-REMOTE ERROR SIGNAL: Turn on the power switch. Adjust the DC voltage control to the desired output voltage. The load may either be connected to the front DC output terminals or the rear DC output terminals. If the load is connected to the rear output terminals, the voltage across the front panel

output terminals is regulated for load except for the very small drop in wires connecting front to rear terminals.

PROCEDURE FOR OPERATING POWER SUPPLY FOR REMOTE ERROR SIGNAL:

With the power supply turned off, remove the jumper bars from the remote error terminals located on the rear terminal board. Use twisted pair wire for connecting the + and - output terminals from the rear of the chassis to the load. Use another set of twisted pair wires connecting the + and - remote error signal terminals to the load contacts. (See Figure I.)

PROCEDURE FOR OPERATING THE POWER SUPPLY FOR REMOTE PROGRAMMING OF THE OUTPUT VOLTAGE:

With the power supply turned off, remove the jumper bars from the remote programming terminals located on the rear terminal board. Use twisted pair wire for connecting the + and - remote programming terminals to the remotely located voltage control. (See Figure II.) The unit is set so that a resistance change of 300 ohms in the remotely located voltage control will cause a change in output voltage of approximately 1 volt.

Procedure for selecting the remote programming control - The remote control circuit is designed so that a change of 300 ohms causes a change in the output voltage of approximately 1 volt. To remotely change the voltage through the operating range 0 to 32 volts, it is necessary to change the remote control from 0 to 10,000 ohms. If remote control over a limited voltage range is desired (e.g. 28 to 32 volts) the remote control must be changed from approximately 8,000 ohms to 10,000 ohms.

REMOTE ERROR CONNECTIONS

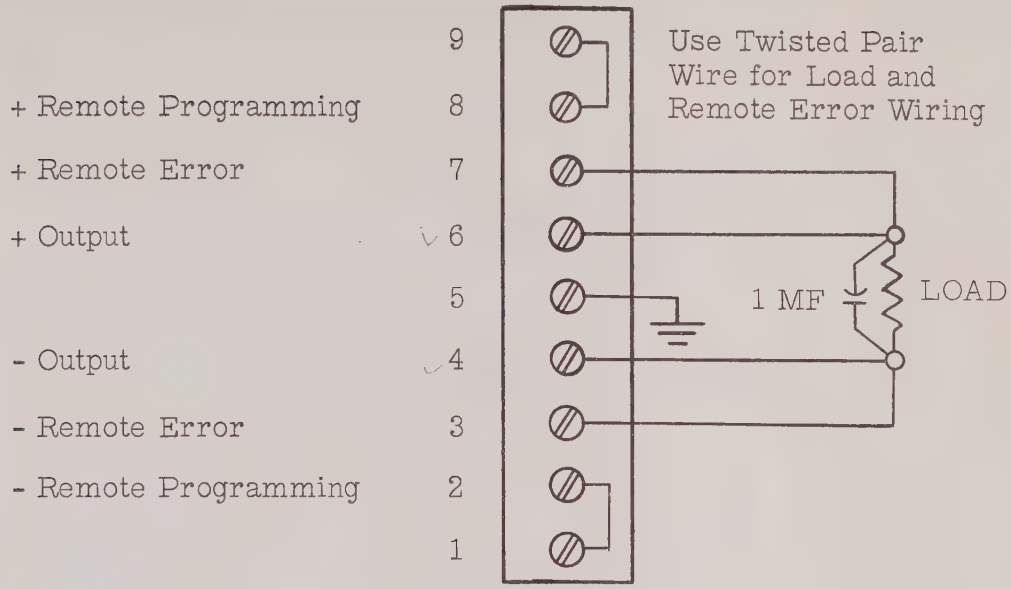


FIGURE I.

Note: When very long remote sensing leads are used, the "Maximum Current Adjust" must be reset. (See "Current Limit Adjust" instructions.)

REMOTE VOLTAGE CONTROL CONNECTIONS

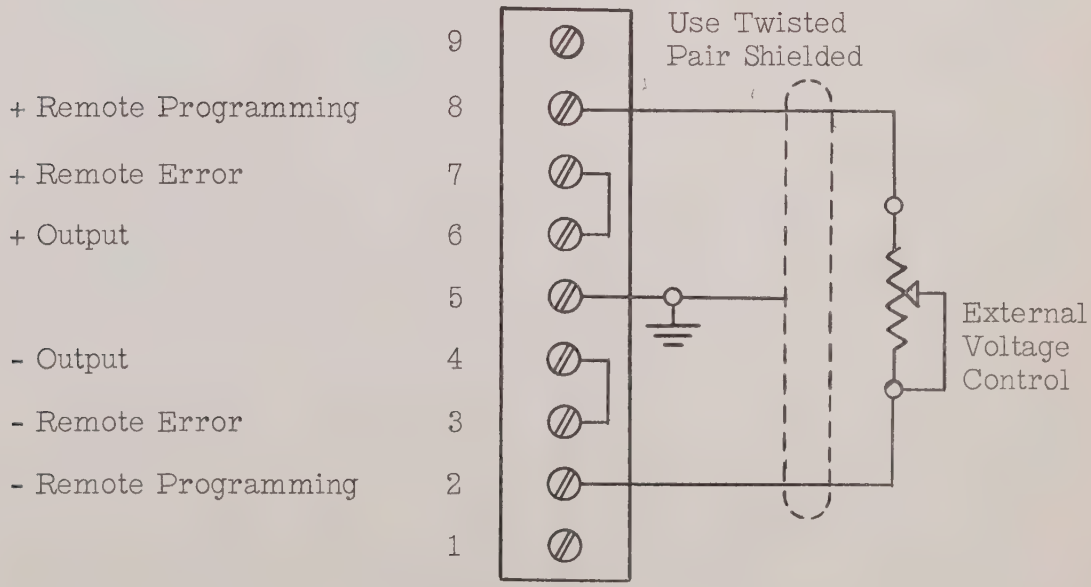


FIGURE II.

PROCEDURE FOR CONVERTING THIS VOLTAGE REGULATED POWER SUPPLY TO A CURRENT REGULATED POWER SUPPLY:

This supply can be operated in such a manner that a constant current rather than constant voltage can be maintained in the external load. Applications for this type of modification include maintaining constant current through magnet coils, solenoids, and filament loads.

Figure III indicates the external electrical modifications required for converting to a constant current mode of operation. The essential changes include removing the minus remote programming jumper, inserting a current sensing resistor R in series with the external load R_L, inserting a 2,000 MF capacitor across R_L, and a 500 ohm control for setting the constant current value.

The value of the current sensing resistor R is selected so that there is a 1 volt drop across it for maximum output current. For example: If the maximum current is to be 1 ampere R is 1.0 ohm. In this case, the output current can be set anywhere in the range 0 to 1 ampere with the constant current control.

When the supply is to be used at a much lower current level than the maximum output current, best current regulation can be achieved by selecting the largest value of current sensing resistor R. For example, if the maximum current is to be 0.1 ampere, the current sensing resistor R should be 10 ohms. For this case, the output current can be set anywhere in the range 0 to 0.1 ampere with the constant current control.

Constant current will be maintained throughout the impedance range 0 to R_L (MAX.). R_L (MAX.) is determined by the equation -

R_L (MAX.) = V (MAX.)/I.

e.g.: V (MAX.) = 32 V, I = 0.5 A, R_L (MAX.) = 64 ohms.

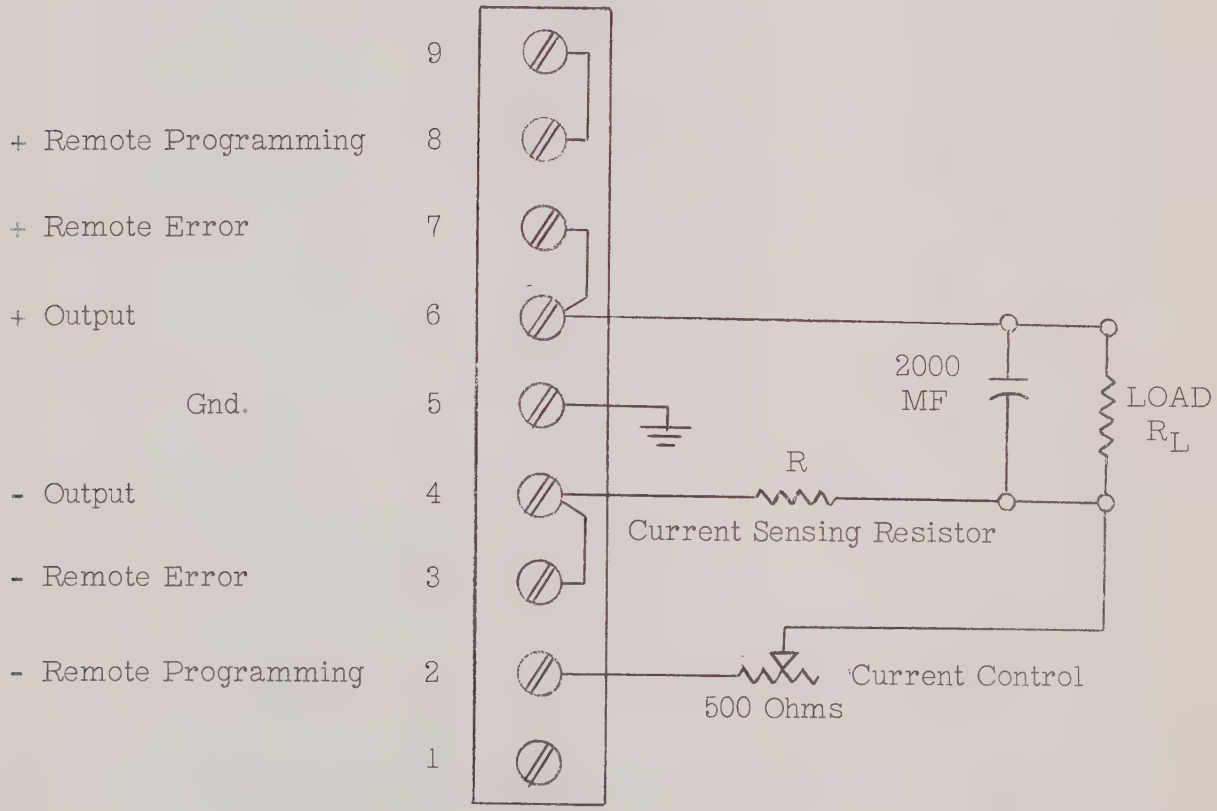


FIGURE III.

CURRENT LIMIT ADJUST: The automatic current limiting device in this unit is part of the regulator amplifier circuit. When the current starts to exceed a pre-set value, the control amplifier sends a signal to the pass elements limiting the current to a pre-set value. There are two controls which limit the current - the "Maximum Current Adjust" and the "Current Limit Adjust". The "Maximum Current Adjust" is pre-set at the factory to 120% of the rated supply current. The "Current Limit Adjust" control, which is available at the rear of the unit, can be used to limit the current to any value from 0 to 120% of the rated supply current. For example: If it is desired to limit the maximum output current to 0.2 ampere, the procedure for setting this control is as follows -- Load the supply to at least 0.25 ampere. Then turn the "Current Limit Adjust" control counter-clockwise until the output current reduces to 0.2 ampere. The load regulation of the supply becomes larger as the current limit is approached. Therefore, for best current regulation through the operating load current range the "Current Limit Adjust" should be set 20% higher than the maximum desired output current. In the above example the load regulation of the power supply will be within specification from 0 to 0.17 ampere.

"Maximum Current Adjust" corrections when remote programming is used - When long remote sensing leads are used, the "Maximum Current Adjust" should be corrected to compensate for the voltage drop in the load leads Under these circumstances, the unit will limit to a current less than the factory pre-set value. The controls are set in the following manner First, the supply is loaded with a remotely connected resistor which will draw

slightly more than 120% of rated supply current at the indicated supply output voltage. Turn the "Current Limit Adjust" clockwise maximum. The "Maximum Current Adjust" should then be turned clockwise until the output current is exactly 120% of maximum supply current. The "Current Limit Adjust" should now be turned counter-clockwise until the output current is limited to any desired current between 0 and 120% of maximum.

OVER-TEMPERATURE PROTECTION: In the event of fan failure or accidental blocking of air vents, a temperature measuring device mounted on one of the series pass transistor elements will automatically turn the power supply off when the temperature is excessive. Check to see whether the air vents are blocked or the fan is rotating. The fan should be operating even though the power supply has been turned off by the over-temperature protection device. To turn the power supply on again, once an over-temperature condition has occurred, remove the external load from the power supply and wait approximately 3 to 5 minutes for the unit to cool off. After this interval turn the power switch OFF and then ON again. If the power goes off the unit has not cooled to a safe operating temperature. If the fan is operating properly and the air vents are clear there may be internal failure and the internal difficulty should be removed in accordance with the Maintenance and Repair instructions.

If the supply is operating properly re-apply the load and let the unit operate for 10 to 15 minutes. Continued safe operation of the power supply may then be expected. If the supply shuts down with a load not exceeding the rated value of the supply, the unit should be serviced in accordance

with the Maintenance and Repair instructions.

MAINTENANCE: The components of this Semi-Conductor Regulated Power Supply have been selected and tested to provide long and trouble free operating life. Replacement of transistors may be necessary on rare occasions. The transistors in the regulated reference supply and in the reference amplifier are easily accessible by removing the rear cover plate. This cover plate is fastened with three screws. The pass transistors are of a plug-in type and are accessible by removing the power supply from its cabinet. To remove the power supply from its cabinet remove the four feet. The supply can then be removed by sliding the unit out through the front or rear opening.

Maintenance should be done only by qualified personnel who know transistor regulator circuitry. Serious and costly damage can result from inexperienced probing in the unit.

REPAIRS: Should any trouble develop in the instrument, it may be serviced with the aid of the schematic diagram. Major repairs, however, are usually handled by the factory.

Under no circumstances should the instrument be returned to the factory without proper authorization and shipping instructions. In any correspondence with the factory concerning repairs, the type and serial number of the instrument must be given together with a description of the trouble encountered.

PARTS LIST

DRAWING S-TRAM-4-01

C1	- 2	MF	200 WV
C2	- 0.4	MF	50 WV
C3	- 25	MF	25 WV
C4	- 0.1	MF	500 WV

CR1	- Germanium Diode 1N91

Q1	- Transistor 2N441
Q2 thru Q6	- Transistor 2N382 (Alternate 2N383)
Q7	- Transistor 2N35 (Alternate GT-1092)
Q8	- Transistor 2N382 (Alternate 2N383)
Q9	- Transistor GT-1092
Q10	- Transistor 2N35 (Alternate GT-1092)

R1	- 3.3	K	1/2 watt
R2	- 2.2	K	1/2 watt
R3	- 500	Ohm	3 watt WW
R4	- 500	Ohm	3 watt WW
R5	- 4.7	K	1/2 watt
R6	- 2.5	K	3 watt WW
R7	- 2.5	K	3 watt WW
R8	- 10	K	3 watt WW
R9	- 2.5	K	3 watt WW
R10	- 500	Ohm	3 watt WW
R11	- 100	Ohm	3 watt WW
R12	- 100	Ohm	3 watt WW
R13	- 1.8	K	1/2 watt WW
R14	- 10	Ohm	1/2 watt
R15	- 1.5	K	1/2 watt
R16	- 1.8	K	1/2 watt
R17	- 1.5	K	1/2 watt
R18	- 220	Ohm	1/2 watt
R19	- 1.5	K	1/2 watt
R20	- 1.5	K	1/2 watt
R21	- 2.7	K	1/2 watt
R22	- 10	Ohm	1/2 watt
R23	- 100	Ohm	1 watt
R24	- 500	Ohm	2 watt Pot.
R25	- 500	Ohm	2 watt Pot.
R26	- 1 1	K	3 watt WW

RD1	- Diode 1N429

PARTS LIST - MODEL SC-32-1

DRAWING S-SC-32-1-02

B201	- Fan		
C201	- 3300	MF	50 WV
C202	- 2000	MF	80 WV
C203	- 60	MF	250 WV
C204	- 350	MF	50 WV
C205	- 500	MF	12 WV
C206	- 500	MF	12 WV
C207	- 100	MF	12 WV
C208	- 100	MF	12 WV
C209 thru C212	- 0.22	MF	200 WV
C213	- 0.4	MF	50 WV
C214	- 0.1	MF	500 WV
CR201 and CR202	- Silicon Rectifier TM-21		
CR203 and CR204	- Silicon Rectifier PT-5		
CR205 thru CR212	- Germanium Rectifier 1N91		
F101	- 2 Amp. Fuse		
F201	- 1/4 Amp. Fuse		
F202	- 1/4 Amp. Fuse		
M101	- Meter, 0-1 A DC		
M102	- Meter, 0-50 V DC		
PL101	- Neon Pilot Light NE-51		
Q201	- Transistor 2N382 (Alternate 2N383)		
Q202	- Transistor 2N382 (Alternate 2N383)		
Q901 thru Q906	- Transistor 2N441-6		
R101	- 10	K	10 turn Pot.
R201	- 500	Ohm	40 watt WW
R202	- 1.5	Ohm	3 watt WW
R203	- 1	K	1/2 watt
R204	- 2	K	1 watt
R205	- 2.2	K	1 watt
R206	- 1	K	1/2 watt
R207	- 2.2	K	2 watt
R208	- 120	Ohm	2 watt
R209	- 120	Ohm	2 watt

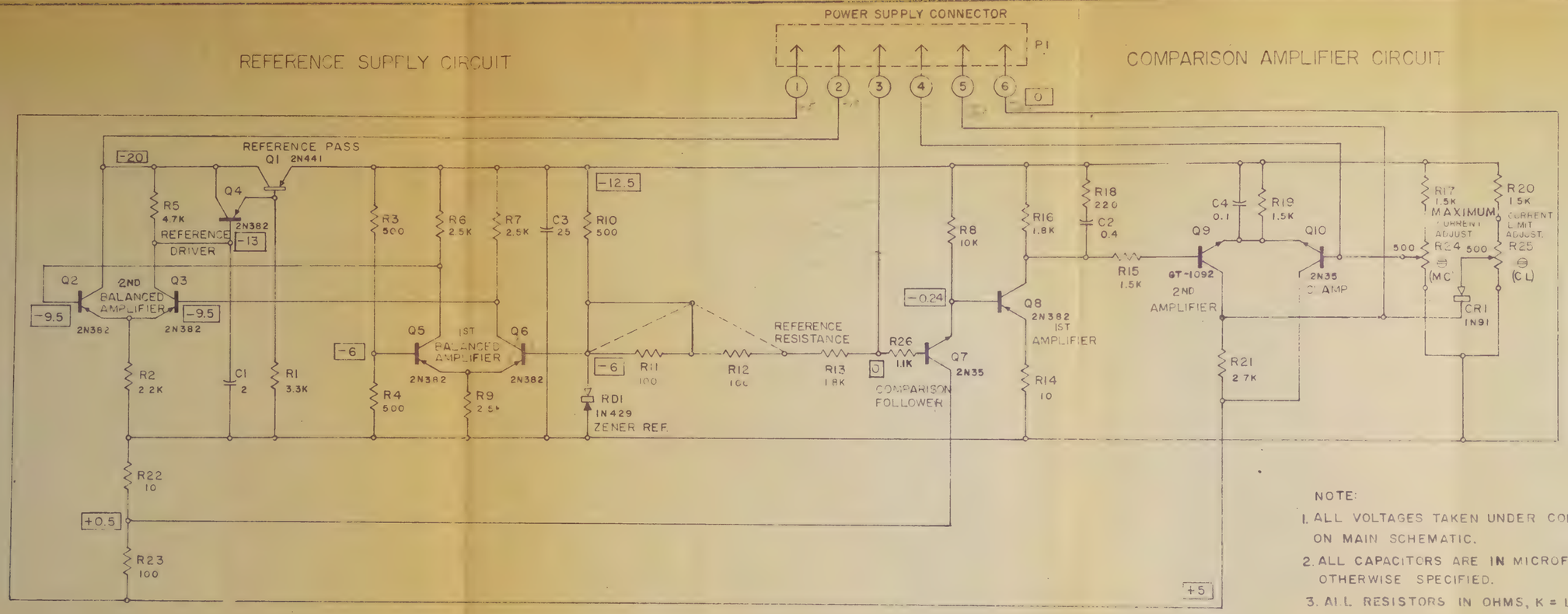
PARTS LIST - MODEL SC-32-1

DRAWING S-SC-32-1-02

R210	- 20	Ohm	1/2 watt
R211	- 500	Ohm	20 watt
R212	- 47	Ohm	1/2 watt
R901 thru R904	- 1.5	Ohm	3 watt WW
RL201	- DPDT Relay		
RL202	- DPDT Relay		
S101	- DPDT Switch		
S201	- Thermoswitch N. O.		
T201	- Kepco #100-1052		
T202	- Kepco #100-1039		
TB201	- Jones #9-140-Y		

REFERENCE SUPPLY CIRCUIT

COMPARISON AMPLIFIER CIRCUIT



NOTE:

1. ALL VOLTAGES TAKEN UNDER CONDITIONS SPECIFIED ON MAIN SCHEMATIC.
2. ALL CAPACITORS ARE IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
3. ALL RESISTORS IN OHMS, K = 1,000 OHMS.

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ITEM CONTROL UNIT

DATE 7-14-59

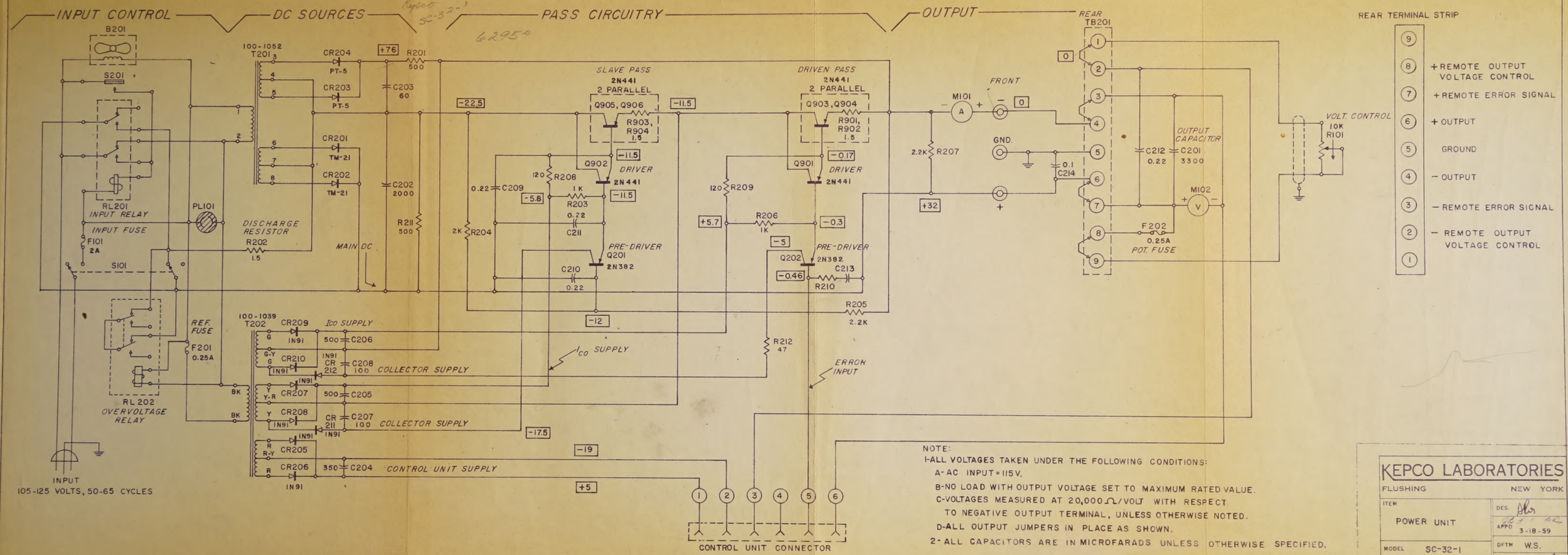
APPD.

BY AAL

MODEL TRAM-4

DWG. No S-TRAM-4-01

CHKD



NOTE:
1-ALL VOLTAGES TAKEN UNDER THE FOLLOWING CONDITIONS:
A-AC INPUT = 115V.
B-NO LOAD WITH OUTPUT VOLTAGE SET TO MAXIMUM RATED VALUE.
C-VOLTAGES MEASURED AT 20,000Ω/VOLT WITH RESPECT TO NEGATIVE OUTPUT TERMINAL, UNLESS OTHERWISE NOTED.
D-ALL OUTPUT JUMPERS IN PLACE AS SHOWN.
2-ALL CAPACITORS ARE IN MICROFARADS UNLESS OTHERWISE SPECIFIED.

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ITEM: POWER UNIT	DES.
	APPD 3-18-59
MODEL SC-32-1	DFTM W.S.
DWG. No. S-SC-32-1-02	CHKD

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Performance
Reliability
and Quality
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